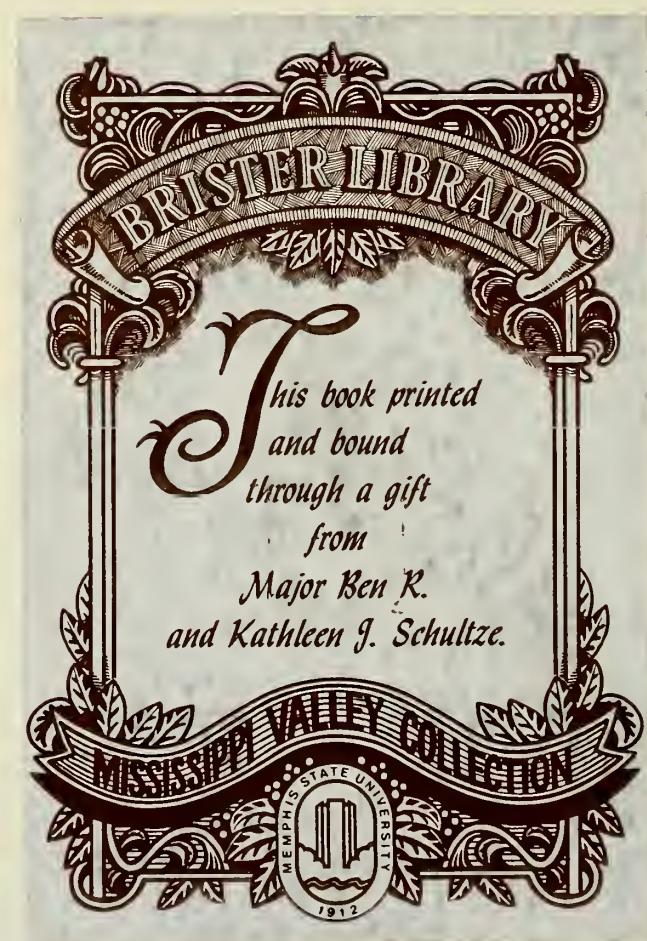


ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY
INTERVIEWS WITH
FRED CHAMBERS

BY - CHARLES W. CRAWFORD
TRANSCRIBER - SHARON C. HESSE
ORAL HISTORY RESEARCH OFFICE
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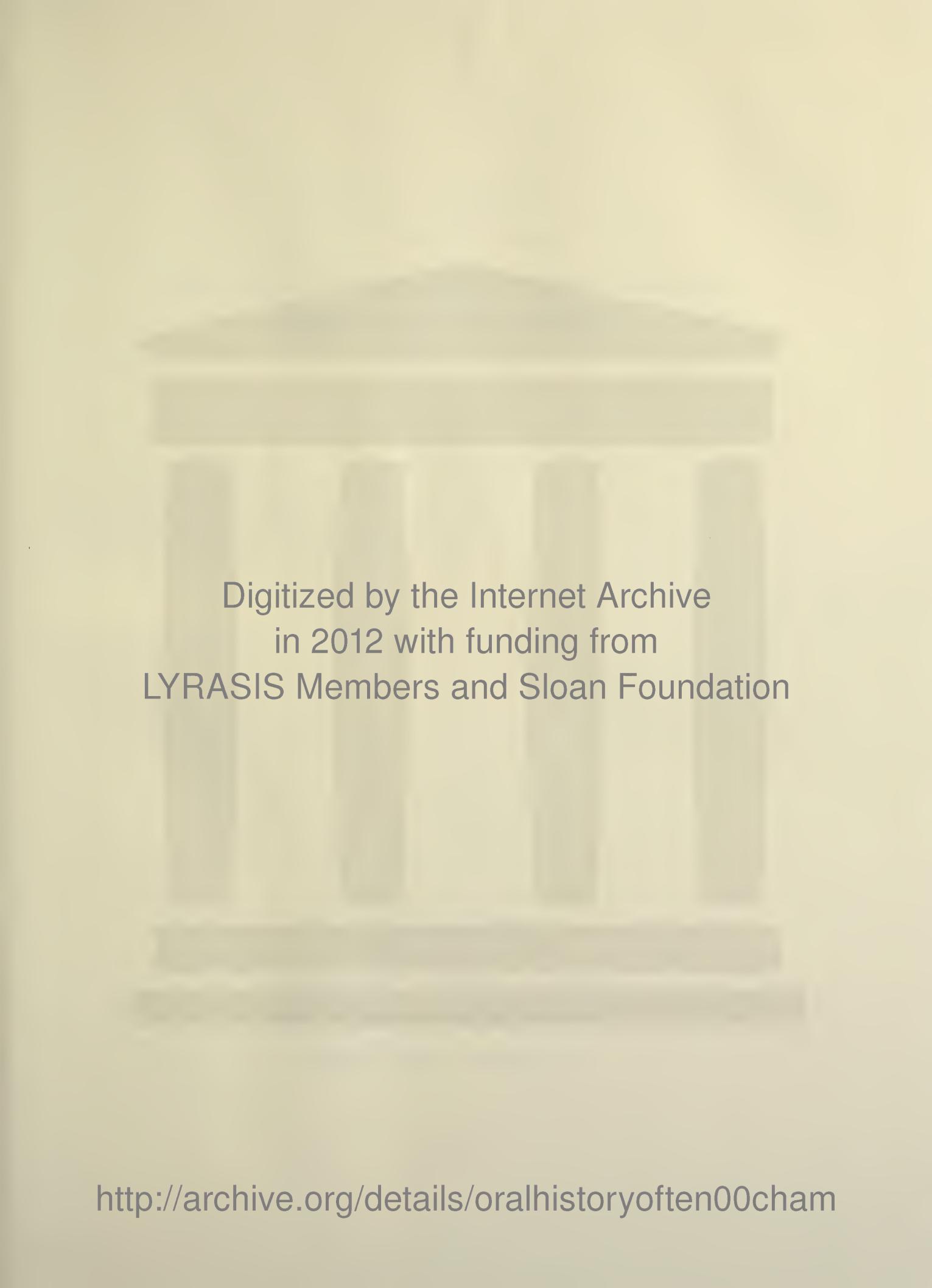
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ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY

INTERVIEWS WITH FRED CHAMBERS

MARCH 3, 1972

BY CHARLES W. CRAWFORD

TRANSCRIBER - SHARON C. HESSE

ORAL HISTORY RESEARCH OFFICE

MEMPHIS STATE UNIVERSITY



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PLACE: Houston, Texas

DATE: March 3, 1972

Fred Chambers
(Interviewee) Fred Chambers

Charles W. Crawford

(For the Mississippi Valley Archives
of the John Willard Brister Library
of Memphis State University)

THIS IS THE ORAL HISTORY RESEARCH OFFICE OF MEMPHIS STATE UNIVERSITY. THIS PROJECT IS "AN ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY." THE PLACE IS HOUSTON, TEXAS. THE DATE IS MARCH 3, 1972, AND THE INTERVIEW IS WITH MR. FRED CHAMBERS, PRESENTLY OF HOUSTON, TEXAS, FORMERLY WITH THE TENNESSEE VALLEY AUTHORITY. THE INTERVIEW IS BY DR. CHARLES W. CRAWFORD, DIRECTOR OF THE MEMPHIS STATE UNIVERSITY ORAL HISTORY RESEARCH OFFICE, AND WAS TRANSCRIBED BY MRS. SHARON C. HESSE.

CRAWFORD Mr. Chambers, I suggest that we start by getting information about you. We might get some information in the nature of personal biography, starting at the beginning and going up to the time that you became associated with TVA.

CHAMBERS Well, I guess the beginning point would occur by being born in 1912 in Carbon Hill, Alabama. I went to high school in that area, and I went to Auburn University, which was then called the Alabama Polytechnic Institute. I finished in the spring of 1930, which many people will recall as being the beginning of the very severe depression. Somehow I was able to get a job, though. I went to work with General Electric Company as test man in Schenectady, New York in the early summer of 1930, and I transferred to their Lynn, Massachusetts works in that fall and did a little work co-oping at MIT on a Master's Degree. In the meanwhile, business continued to get worse and the outlook wasn't so good, so I transferred back to Schenectady. Somehow I was able to hang on with G.E. on that test program until 1932.

During the time, however, two things occurred. One was that there were no promotions. Second, the number of hours work which we did was reduced from 44 to 40, and to 36 and to 32. However, a bright side of this occurred when I got a raise from 55 cents an hour to 63 cents an hour, so it was much better than a lot of people who had no work at all.

Well anyway, I left G.E. in the early part of 1932 and went to work for the Associated Gas and Electric Company in Elmira, New York for a few months during 1932, and following that the retrenchment program of Associated Gas let me out. And it was 1933 before I got any work in the electrical engineering profession. In 1933 I went to work for the Tennessee Electric Power Company located in Harriman, Tennessee as a Division Lighting Sales Representative, having responsibility for lighting sales and for rate applications and work of that nature. There was a good deal of customer relations, and there were four or five men and women in this lighting sales effort.

In 1936 I became Division Meter Superintendent, and in 1939 the Tennessee Electric Power Company, along with other portions of the Commonwealth and Southern group, were bought out by TVA following negotiations between Wendell Willkie and his Commonwealth and Southern colleagues and the TVA people--principally Cap Krug and Joe Swidler. I think the sale price was some \$78,000,000 and on August 15, 1939 the transfer of properties took place. At that time I went with the Chattanooga Electric Power Board in Chattanooga,

Tennessee in their meter department, where I worked for four months until December of 1959. Then I went to work for TVA as a Field Test Engineer in the Electrical Laboratory and Test Branch, which was a part of the Division of Power System Operation. I was located in Jackson, Tennessee, and I did field test engineering on meters, relays--all kinds of power facilities--over the West Tennessee Division, which laid generally west of the Tennessee River to the Mississippi River. It included Memphis. It extended north to Kentucky Dam, which was then under construction, and extended south generally to the Mississippi State line.

This period of time in Jackson ended in May of 1941, when I transferred to Tupelo, Mississippi as District Operating Superintendent. There I had charge of the operation and maintenance of the transmission lines and the substations in north Mississippi. This work was carried out with crews of men to perform this work, and it continued until February 3, 1943 when I went into the Navy in the minesweeping end of the Navy's business. And I did mine-sweeping on the East Coast and on the West Coast and in the Pacific, ending up in Okinawa in the late fall of 1945. I came back to TVA in January 1, 1946 and resumed the job I had as District Operator Superintendent of Tupelo, Mississippi.

I continued this at Tupelo until August of 1946, when I transferred to Nashville, Tennessee as Assistant Division Engineer, helping the division engineer, whose responsibilities included the operation and maintenance of all the transmission lines and substations in the central district with headquarters at Nashville. The Central District was composed of three--I guess

I ought to say Central Division, that was the term in those days. The Central Division was composed of three districts, one headquartered at Columbia, one at Russville, Kentucky, and one at Murfreesboro. During the time I was there, there were some changes made, but the character of the work remained the same. And in August of 1950, virtually four years to the day, I transferred to Chattanooga, Tennessee, which is the headquarters of the Office of Power, and I became an Assistant to the Chief Power Engineer. His name was Merrill DeMerit. He's a man of whom I think you've probably already heard from others. He's a man who came to TVA about 1940 from the West Penn system where he was associated with the Manager of Power, Mr. Wessenhauer. This man was one of the outstanding electric system engineers anywhere in the United States. His competence and stature was very high. It was a real privilege to work for him. He came with TVA at about age fifty, and I became associated with him in 1950 when his age was about sixty. And for a ten year period I worked with him, until 1960, when he retired. During that period there was much of the TVA's "casting of the die" of the planning of its power system that was established. Mr. DeMerit retired in 1960, and then I became Assistant Director of the Division of Power Planning and Engineering. The director of that division was named K. E. Hapgood.

CRAWFORD Kenneth Hapgood, I believe.

CHAMBERS Do you have Hapgood?

CRAWFORD No, sir. Where is he now?

CHAMBERS He's in Chattanooga; he's retired. K. E. Hapgood.

This Division of Power Planning and Engineering was responsible for the planning, engineering, design, and construction scheduling for the entire transmission system. It was also responsible for the planning and the recommendations for the power supply. This meant generating facilities and any arrangements or contracts entered into with the neighboring systems. The division was not responsible for either the design, engineering, or construction of the power plants themselves; although, the division, of course, did prescribe certain features of the power plants and of the equipment that went in it--the characteristics of the generators, the short circuit ratio, the response of the generators, and these things. It also prescribed the terminals of the transmission facilities so that they would match the terminals to the system where the power and energy were introduced to the transmission system. It was called the Division of Power Planning and Engineering.

I was made Director of that division in 1963, and Mr. Hapgood was transferred to be an Assistant to the Manager of Power. And I think perhaps maybe one year later Mr. Hapgood retired. In any case, this continued to the first part of January, 1970 when the Manager of Power, G. O. Wessenauer, retired, and he was succeeded by his assistant, the Assistant Manager of Power at that time, J. E. Watson. And shortly after this, perhaps in February or March 1970, I transferred to become Assistant Manager of Power to Jim Watson, with particular responsibilities relating to the engineering and planning. Then this continued until September 4, 1971, when I elected to take early retirement, and I did effective on that date.

Following this retirement I had planned to take some fairly extended vacation and recreation time. However, I found myself working again a little earlier than I had planned, because November 1, 1972 I became associated with Bovay Engineers, Inc., in Houston, Texas, and here I am. That's the rundown.

CRAWFORD All right, we have the survey, Mr. Chambers, so let's go back and get some information in different parts of this. To begin with, what did you study at Auburn, and can you tell something about your early employment experience and what you learned there that fitted into your TVA work?

CHAMBERS Well, at Auburn I studied electrical engineering, and I got a degree in electrical. And in those days the power option was it, because electronics had not advanced to the point that it now is. When I went with General Electric Company I found a situation which was most delightful, because the arrangement permitted the test men to do actual work with their hands. We did a lot of the wiring up of the equipment that we tested. The purpose in the test, of course, was to be assured that the particular product or equipment that had been made would meet the specifications and meet the requirements that the customer had established and that the design contemplated. And these tests were carried out for that purpose.

Sometimes the design engineers wanted further information for more design guidance. In any case, I think that it probably would not be permissible today for engineers to work with their hands. But I can tell you that there's a lot learned by this--to get dirty and crawl around and do this.

CRAWFORD You started at a good time, didn't you?

CHAMBERS Yes, I did. The problem at the time, though, was the setting in of this major depression, which was thought to be possibly transient in nature, but it didn't turn out that way, and business declined and orders declined. The production declined, and we weren't as busy as we would have liked to have been. We occasionally got a job that had a lot of priority to it and we were able to work a little overtime, and that helped with the money. And of course, it's always fun when things go wrong and you have a little opportunity to analyze and see what's needed. But it was an excellent experience: the kind that's, I guess, not available today, and I think that it results in an understanding for engineers for the practical side of the problems that arise later on. It was with the Tennessee Electric Power Company. I knew all about what the repairmen and maintenance men were doing because I had been there, and in TVA it was the same way. I had an understanding of how those men worked better than I could have gotten any other way.

CRAWFORD Now, what locations did you work for G.E.? I believe you were in New York. Did you work at other places also?

CHAMBERS Well, first I went to Schenectady, New York. This was considered their biggest and main plant, and I worked there from June 1930 to the fall of 1930, where I transferred to their plant at Lynn, Massachusetts, which is just north of Boston and was accessible to MIT to do a little co-op work. Well, there were really two plants at Lynn, and I was at the one called the West Lynn Works. There I did work with transformers--small transformer testing--and some small motor and generator testing. But here again, work was slack. It was just unfortunate that things weren't better. That's when they started cutting down the number of hours we worked.

CRAWFORD Did you do anything in connection with MIT while you were there?

CHAMBERS Well, I took an advanced course that could have led to a Masters degree. If I had continued this at the same rate, it would have taken two years. But it was pretty obvious--at least I thought at the time--in early 1931, that every week could have been the last week. I don't really know how I hung on until 1932. What helped me I think was when I went back to Schenectady, recognizing that my days were numbered, I found a test in the illuminating engineering laboratory where, in doing this work, I was given what was called a sign-up assignment. This meant that I was signed up to stay with that test for six months, and it turned out to be nine months, because the test programming needed me to

continue to its conclusion, and I got virtually a nine months reprieve, I suppose you might say, which extended me into 1932. But things were bad in those days. You see, I was just out of college, and relatively speaking, there were men much more competent and better qualified than I that had since lost their jobs, so I just had a stroke of luck--that's all.

CRAWFORD It was a very bad time for engineering, as it was for most things, in the early '30s.

CHAMBERS Sure.

CRAWFORD What was the nature of your work with Associated Gas and Electric?

CHAMBERS Well, I had gotten this job through connections of the illuminating engineering laboratory of the General Electric Company, and there I went to work for a man named Howard Sharp, who was one of the top notch, in those days, lighting men in the United States. He became president of the Illuminating Engineering Society. He had ambitions for doing a real good job for Associated, and he put me to work in what was a usual pattern in those days of a young engineer. He said, "You go survey the street lighting system," because there was always a need of surveys. Those things grew like Topsy. They were series systems that always had places to cut out wire. So I did this, and I figure it took me about four months to do it, and it got me acquainted, of course--the secondary purpose or maybe primary, was to get me acquainted with the system in Elmira, New York. I got to know it real well--the streets and all the circuits and everything. And about that time the president

of Associated Gas, who was not the essence of respectability in utility circles, whose name was Howard Hobson, sent out an edict that everybody that had been hired within the past year should be terminated, so I was caught in this in 1932. This was not of Howard Hobson's making, but his behavior probably contributed to problems. This was later corrected by the Securities Exchange Commission.

Anyway, I left them, or they left me, in 1932 and I went back to Alabama. And there I had different little jobs, none of significance much, but anything that would provide any income at all, I did. I did some work on some of the loan programs that the government established when Roosevelt came in and established all these various agencies. I really didn't do any more professional work until 1933, when I got a job with the Tennessee Electric Power Company. And here again, it began in the lighting end of the business because of the connections that I had in that part of the industry. And the head of lighting of the Tennessee Electric Power Company, a man named Buford Martin, interviewed me because Howard Sharp in Elmira, New York had written him a letter about me. And so Buford Martin did this, and he arranged for me to go to work as Division Lighting Sales Manager in the north Tennessee district of the Tennessee Electric Power Company in Harriman, Tennessee. There were a couple of girls who did residential lighting promotional work and related wage work and a couple of men who did commercial and industrial lighting work. This continued then for about three years, from about 1933 to about 1936.

CRAWFORD That's when you became Division Meter Superintendent?

CHAMBERS That's right. I don't know how much detail you want.

CRAWFORD What was the nature of your work then as Division
 Meter Superintendent?

CHAMBERS Well, I was responsible for the purchasing of meters,
 their testing, calibration, and shipment to the local
 offices located in that division where they would then
be installed to register the power and energy delivered to the
customers in each of these local areas. I also had the responsibility
for a testing program, routine as well as special testing, as
required to be assured of their accuracy, and the record keeping.
And then the Tennessee Electric Power Company, like many companies
in those days, had a program of selling merchandise and appliances.
It came under my supervision to develop the program for installation
of ranges, water heaters, and refrigerators to provide for their
electrical and water connection. And some of this, the power company
did with its own people and some of this was done by contract with
electrical contractors. The meters involved principally, of course,
residential watt-hour meters, but some were recording demand power
meter type.

CRAWFORD Of course TVA had its later counterpart of all these
 things, didn't it?

CHAMBERS Well, not really. You see, TVA began essentially and continued as a bulk power supply system. They generated electricity, and they transmitted and they supplied at wholesale to the distributors which now amount to about 160. It is true that in the very beginning in some limited areas TVA did do some of what I'll call distribution work, which involved the extension of the lower voltage distribution class lines, out to the residential and commercial areas where distribution transformers would be installed to step down and provide the service. But I don't think TVA ever really did any distribution work, except to meet a need in essentially a temporary fashion, and then turn it over to a distributor to do that part of the work in that area. So much of what I did for Tennessee Electric Power Company is now carried out by the distributors of TVA electricity.

CRAWFORD In early days TVA did this in encouraging use of electrical appliances, didn't they?

CHAMBERS Oh, yes. The whole idea of TVA was, I think, not necessarily electricity unto itself, but was to provide a better standard of living in the area. Now with an admitted biasness on my part, I think the greatest source of power available to the customer is electricity. And so it helps the standard of living, to pump water, or to heat water, or to cook food, or to grind up stock food, or the many jobs about the house in addition to the commercial and industrial uses, it's a human labor saving device. So TVA promoted electricity to do a lot of jobs...again, I don't think for promotion of electricity unto itself,

but rather to promote a better standard of living.

CRAWFORD During this time then in 1936 to 1939 you continued to work as Division Meter Superintendent for Tennessee Electric Power. When did it become apparent to the employees of the company that TVA was going to buy Tennessee Electric?

CHAMBERS Well, there was a thing called the Ashwander Case, which was tried in Chattanooga by a three-judge, federal court. And it was something that some eighteen or nineteen utilities joined together in an effort to make a comprehensive test, I think, of the TVA act and an effort, I suppose, to kill it. And the outcome of this Ashwander Case was favorable to TVA. This resulted in it being apparent that TVA was going to buy the Tennessee Electric Power Company, and it was going to take over the bulk power supply facility--that's generation and transmission--and it was going to seek arrangements for agencies to operate the distribution facilities. So it was a period that I can't recall. It may be, oh, a year and a half or two years or something that this was apparent.

The announcement, I recall, was made in February of 1939 because there was a fairly major flood that occurred in Harriman, Tennessee. I think February 3 the water of the Emery River rose and flooded out the substation, and the electricity went off, and the restoration of service was not accomplished until about three or four o'clock in the morning of February 3. I guess the flood began on

February 2. We all worked like dogs day and night. I waded around in boots and tried to find ways to bypass facilities so that the transmission line could be re-energized, and after some long extended work I joined maybe 35 or 40 other men who had gotten the lights back on. We went into a little restaurant in Harriman to get some coffee and food, and the papers from Chattanooga arrived with Willkie announcing the sale of TVA for \$78,000,000. We all were a little bit crestfallen, but we knew it was coming. It was not really a surprise.

CRAWFORD How did the employees of the power company feel about this? Did they welcome it? Were they unhappy with the sale?

CHAMBERS I don't think they really welcomed it. You see, this had been going on from 1933 now until this Ashwander Case, and the employees had been encouraged by Tennessee Electric Power and by Commonwealth and Southern that they were right to fight it, that they were fighting for motherhood, you know--a lot of these things. And they were told that if they would perform their job and fight this thing that they would be taken care of in return for this. And I think one of the major disappointments of the takeover was the fact that the private power sector absolutely welched on that representation almost completely. A very small handful of Tennessee Electric Power Company employees found employment with other private utilities. The vast majority found

themselves without a job, and I was one of them. I got a job with the Chattanooga Electric Power Board in their Meter Department, because that was the area of work that I was doing then, but I got it right at the last minute. And there was a period from February of 1939 until August 1939 where all of these Tennessee Electric Power Company people who had no job in sight...And you'll recall that in 1939 some of the melody of the depression lingered on. It was not nearly as bad, of course, as it was in the early '30s, but the industrial picture was not bright. And so there was a pretty nice gentlemanly practice that was carried out where if a man with a power company heard of a job some place, all of his friends helped him. There was no competition at all where one tried to get a job that another one had found. I made a lot of effort and a lot of others did too to find jobs for people who worked under my supervision.

CRAWFORD Were you successful in finding many?

CHAMBERS I did. I located a job for all except one, and he didn't really want one. He wanted to move to Florida and retire. But then it was only a couple of weeks--it was the first of August--before I had a job identified, and that was with Chattanooga Electric Power Board's Meter Department, and it was a job testing meters; but it was a job. Then there were others who took longer--an extended period--for some of them to get a job. But it was real disappointing the number of private systems who did not take anybody, and there were some real good opportunities there.

CRAWFORD Did the private power systems just not try to help?

CHAMBERS That's correct. They didn't try. Those eighteen or nineteen who were represented in this Ashwander Case did nothing. Even the other companies of Commonwealth and Southern only took one and two here and there. They didn't really extend themselves, and they did have an opportunity to get some good competent employees. Of course, as far as I'm concerned, I think I came out real lucky.

CRAWFORD But it must have been a disappointment that they did not help.

CHAMBERS Yes, it was that.

CRAWFORD You were only with the Chattanooga Electric Power Board a short time.

CHAMBERS Four months, yes. Then my friend named C. A. Duke, head of the electrical laboratory and test activity of the Tennessee Electric Power Company, was offered a job at TVA in that same or similar capacity, and Cliff and I had been friends a long time, so he immediately set out to see if I could go to work in his organization, which I was happy to do.

CRAWFORD Did you have any change of job while you were with the Chattanooga Electric Power Board?

CHAMBERS No, it was only a four-month period, and I worked

for a man there who was named E. E. Doudna. He's dead now and he came there from Carolina Power and Light, and he hadn't been with Chattanooga Electric Power Board very long. He was the Meter Superintendent of that organization.

CRAWFORD What month were you taken into TVA?

CHAMBERS December 15, 1939, and it was one of the coldest winters. You know there's a cyclic weather pattern, and every seven or eight years was an unusually severe winter, and this was one of them. It was a winter in which the Tennessee River froze over at Chattanooga. I think some damn fool drove a car across the river there. The Mississippi almost froze at Memphis. And when I went to Jackson in December I found myself spending a fair amount of time up at Kentucky Dam in an effort to cut in a substation to provide construction power supplied from the Kentucky Utility 69 KV lines, and there I was absolutely the coldest I've ever been--riding that ferry across the Tennessee River to that project. I remember it got down in Jackson to 17 below zero.

CRAWFORD That's very unusual for there.

CHAMBERS Yes, it is. It's very unusual, but it was a severe winter. My first winter with TVA was a real lulu, and we heated with coal. It was just a question of shoveling coal all the time.

CRAWFORD Did you fear that there would be any reluctance on

the part of TVA to hire employees with the Tennessee Electric Power Company?

CHAMBERS No, I don't think so. I think the atmosphere or the attitude of the TVA employees toward the TEP employees was good. There might have been an exception; I'm sure there were here and there. But actually the relationship as far as I'm concerned was good and as far as I observed was good, but you have to recognize that the TVA employees at that time were all people--almost all people--who came also from the private sector and who were laid off, for example Stone and Webster, Ebasco, and all the large consulting firms that found themselves having to lay people off. And then some of the electric systems themselves had done retrenching work--well like Associated Gas did with me. And so we found with TVA they were channeling people who had worked for other systems and professionalism prevailed. I don't think there was any substantial feeling at all.

Then there was this sort of aggressive spirit of accomplishment that provided an opportunity to do something. During so much of the early thirties, whoever had been where was in a kind of lackadaisical environment. In an effort to reduce costs, they weren't doing too much. Well, here is a TVA that says, "We've identified something. Here are many square miles--80,000 more or less--where the rural areas have such an insignificant amount of electricity available, and we're going to provide it. And we can do it, and we're going to tame this river, and we're going to

do these things." And this spirit sort of hit everybody.

CRAWFORD Who were the first people in TVA you came in contact with?

CHAMBERS Well, I suppose that my functional work was for Cliff Duke, who was responsible for the technical program of the electrical laboratory and test branch. That is, this is the responsibility for providing the standards, prescribing the methods used to test these facilities, and he was my functional boss. And he was my real boss, but I was located in Jackson, Tennessee, which is the location of the West Tennessee Division Office, whose Division Manager at the time was named Earle Wall. Earle is still alive.

CRAWFORD Yes, sir, I have talked to Mr. Wall.

CHAMBERS Well, this is good because, as Division Manager, he was responsible for the TVA program to the distribution in that area and to the public. Now, while I worked for the Chattanooga organization, certainly it was my job to be sure that I cooperated in TVA's comprehensive effort and in it getting its job done and its relations acceptable. Then there were others who didn't work under Earle Wall at all, who did power construction or who did other things in the TVA program, but they also were to, and did, cooperate with Earle Wall. And Earle Wall's division office was responsible for the power program in the West Tennessee division. He was not responsible, and didn't have anything to do, with some of the other TVA programs in the area. Although here again, the coordination--this is the thing about TVA: coordination comes

naturally, and it's part of what made it go, and part of what makes it still a good place to work because of the spirit that prevails there between different sectors of TVA.

CRAWFORD And it was in December that you moved to Jackson?

CHAMBERS Yes.

and the power of the human imagination can convert the most banal scenes into something of great beauty and a source of pleasure. It is this kind of imagination that we must develop. And it is this kind of imagination that we must develop in our students.

—John Dewey, *Art as Experience* (1938), p. 100

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THIS IS THE ORAL HISTORY RESEARCH OFFICE OF MEMPHIS STATE UNIVERSITY. THIS PROJECT IS "AN ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY." THE PLACE IS HOUSTON, TEXAS. THE DATE IS MARCH 3, 1972, AND THIS IS INTERVIEW NUMBER TWO WITH MR. FRED CHAMBERS. THE INTERVIEW IS BY DR. CHARLES W. CRAWFORD, DIRECTOR OF THE MEMPHIS STATE UNIVERSITY ORAL HISTORY RESEARCH OFFICE, AND WAS TRANSCRIBED BY MRS. SHARON C. HESSE.

CRAWFORD Mr. Chambers, let's deal now with the beginning of your experience with TVA when you moved to Jackson and try to get together an account of what you did in the power division there and the contacts that you had with the other parts of TVA. You mentioned coordination, and I'd like to get some information about that, too.

CHAMBERS Well, for example, I was a field test engineer located in Jackson, and I did a good deal of work with the operating organizations of the West Tennessee area, under the supervision of Earle Wall, because the work that was done on the system many times had to be coordinated with the distributors which might be involved. This means that some work that might have to have been done would require an interruption to service to a distributor, and would have to be coordinated. That always turned out to be 12 midnight--the most convenient time to arrange an interruption. But anyway, Earle Wall's people had the responsibility for the relations with distributors, and

they did the arranging of interruptions. I also worked with the power construction people who were building transmission lines and who were building substations or modifying them. And here the equipment and facilities would be installed as the design and engineering called for, and then they must be tested to be assured that they were connected right and that they have the right settings and that the instruments are going to read correctly; that the meters register correctly; that the voltage will be right. And so as construction work was going on, it was necessary for the laboratory men to stay right up with them in the checking.

It's a form of a quality assurance program that is carried out to be sure that it's going to work right. And then some of this involved change-overs to put the new facilities in service maybe which would require an interruption to electric service, and here's where the midnight came in when the change-over was made to the new source for that particular area. There's something about this work that I think is not essential. It just always turns out that way--that all construction work is carried out in mud and rain and under adverse conditions, and if the mud isn't there, I guess they have to haul it in to work in. But then the interruptions always occur at midnight, and sometimes the weather is pretty bad then, but you get to points where you can't turn around.

Well, then I also worked in Jackson with the generating plant people of power production. For example, I found myself going down to Pickwick Dam for routine and emergency adjustments, calibration

and trouble shooting of meters and telemeters and load controllers and the things that are associated with a generating plant. And so the field test engineer worked with quite a number of other organizations in TVA as well as the TVA distributors. And he had an opportunity, I think, to help coordinate TVA's work and TVA's image, and it gave him a good overall view of some of the TVA program. I enjoyed working in Jackson in the West Tennessee Division.

CRAWFORD Did you travel much when you were there through the division?

CHAMBERS I guess about half the time I found myself either in Memphis or Kentucky Dam or maybe a little less, and then the other half I could get back to Jackson at night. The weekends frequently turned out to be the busiest times we had, because much of the work had to be carried out at a time when the load was light, so that some alternate arrangements of facilities would be adequate to supply the load while you took out certain main elements of lines or substations or generating units. So the weekends, sometimes beginning Friday night when the load went down, up until the load came up again early Monday morning, was the busiest time that we had. Altogether there was a lot of fun in connection with that. I know you look back and remember only the good things, but it was even fun then in the long hours because of what we were doing.

CRAWFORD Well, you were doing what you wanted to do, and long hours of work are no problem apparently when it's what you like to do.

CHAMBERS Well, it's what you're accomplishing is vividly in front of you. Now, as we sit here and talk or you sit at a desk and do something, it's not quite the same thing as being out and doing something. When you get all through, you close a switch and you see services restored after some tornado damage or something. You've worked a long time, but here's a county or a piece of a county that has electricity back. It's vividly in front of you--what you've done, rather than sitting back and dealing with something that's farther off. I don't think I'm saying this very well, but it's that kind of a thing of being right there where the action is, I guess.

CRAWFORD Why was the headquarters placed in Jackson?

CHAMBERS I think it was just a choice, and I think it was a good one. The TVA power system in the beginning didn't cover 80,000 square miles, but it covered some area. And so there was a matter of where do you put division headquarters with the people who will represent TVA and carry out TVA's power system work in that area, and it's in regard to travel and to being able to provide expeditious service, as well as economy. At one time it was located in Memphis. Memphis is right on the edge, because there's a river there and TVA doesn't go beyond the river, and so it was moved to Jackson. Then Nashville was chosen, and Wilson Dam was chosen; Tupelo was chosen--somewhat on the same basis. It was a good central choice.

CRAWFORD Mississippi was in another division, wasn't it?

CHAMBERS Yes, it was. I just gave Tupelo as being an illustration.

Also in the beginning, Mississippi was not another division; Mississippi was a part of the western division. But it became a division of its own, because the facilities located in north Mississippi were just simply extensive enough that it warranted a division office. They had, oh, about 38 or 40 distributors there who had to be contacted and worked with to carry out the program.

You see, this whole TVA power program is dependent on these distributors. If they fall down on their job, then TVA's program is dead. If the ultimate customer comes up and says, "my service is unacceptable, it's no good," TVA can't go say, "Well, now look what a nice job we do of bulk power." They say, "That doesn't make a doggone bit of difference; your program is not acceptable. I want something else." So it's in TVA's interest to be sure that they do a good job. It's also to TVA's interest to avoid bossing them or telling them what to do. They are recognized by TVA as being local organizations that will meet their local needs. They'll do it in a manner that is compatible with the power program, which generally means that they will use their efforts and monies for the power program and not for anything else.

CRAWFORD Did you have cases where there were attempts to use the money for something else, such as a lower tax rate?

CHAMBERS Oh, sure. Yes, this is human nature. The power program in most of the areas was carried out by distributors who were doing a good job, and they had good managers and good boards. And the other political entities in the area sometimes looked at them with a little

jealousy and said, "Well, look, these folks have some funds; they have some surpluses. We'd like to get some for some streets or for some very worthy city causes." I don't debate that. But the TVA power contracts prohibit the use of funds for any purposes except those related with their power program, so then they seek ways how they can do it. Maybe they would, for example, build a municipal building for housing the municipal services; and then the electric system would occupy some space and pay an exorbitant rate for it. Or you might turn it around--the electric system builds a building with its funds and lets the other municipal operations occupy space at too low a rate.

There were all kinds of ideas that were being developed to get some of the funds away from the electric operations, and because of this, the TVA has a monitoring program with accountants that go around and review the accounts of all its distributors, and that's about all that TVA does review. The other phases of the operation, insofar as TVA is concerned, is carried out strictly by persuasion. That is, you just go to that distributor and persuade him to do a good job. The only thing that TVA is really concerned with is the use of funds. No, that's not right. It's not the only thing they're really concerned with. They're concerned with them doing a good job, because they know if they don't, TVA's program is not going to last. But they are particularly concerned about the funds.

CRAWFORD How did you deal with this problem of the tendency of distributors of power to use it for unacceptable purposes? What sort of control could you maintain over them?

CHAMBERS Well, the use of power. They can't use the power for any purpose, of course, except to supply their customers. It's the customers who take the power. I mean, you can't push power; it has to be pulled. The power funds are what I was referring to as being not permitted to be used for any purposes except related to the power program. Now these are the most specific terms in the power contract. It's spelled out that they can use their revenues to pay their bills to TVA for the power and energy. They can use it to pay their debt service--the annual cost, you know, the interest, amortization and these things of their power system. They can use it for all of their cost of power operations. Now these have to be true power operating costs. They can't be costs of somebody who does something for somebody else or some other phase of the program. The funds can also be used to accumulate a reasonable reserve. This means to have some money available if there's a major event like a tornado that's expensive to make repairs, and beyond that, they have to reduce rates. There's nothing permissible for the use of power funds for anything except the power program, and this is good. The distributors like this very much, because if somebody comes along and says, "We'd like to get a contribution from the power system for some civil purpose," the distributor can respond, "Well, you know I would really like to do this the best of anything in the world, but the contract with TVA doesn't permit it, you see." So they have a good way of turning them down.

CRAWFORD That gives them something to follow. Now this is built into the power contract, isn't it?

CHAMBERS It's built into the power contract very specifically, and it's darn near the only thing that is built in it. The rest of it is by persuasion. If the distributor doesn't do a good job of providing service to his customers, there's nothing that TVA can do about it really, except to go and talk to him and say, "Please, won't you do a better job?" I suppose if they got to be intolerable, TVA could go to the board and say, "Your manager and your people are doing such a terribly poor job that something has to be done. They have to be swept out and get somebody in here that will do a job." But you see, TVA would never get to that, because the ones who were hurting the worst are the customers, and they'd be rising up against the distributor. TVA goes to a lot of trouble to be sure that each distributor is a local agency carrying out its job and that TVA is not telling it how to do its job, except for this financing policing.

CRAWFORD That was the only control you insisted on maintaining?

CHAMBERS This is right.

CRAWFORD What about the persuasion aspect of it. It seems to me that you had to do a great deal of public relations selling. Were there any problems in that? Did you enjoy that sort of work?

CHAMBERS Sure. There were distributors and distributors' managers who were not in accord with some of TVA's views about the service that should be provided. There were distributors, for example, who had managers who thought that electric heat was a mistake, and they opposed it. Despite TVA's effort to persuade them, they still almost said, "Well, you can just go to hell. We'll run this system the way we want to. We're going to pay our bills. We're going to take our service. We're going to comply with the requirements of the power contract, but it's not in our contract to promote electric heat." One of the very biggest ones had that attitude. As time passed, the ones involved--the personalities involved--changed their minds, and it was persuasion. In another case, one of the very large ones never changed his mind. He retired and was succeeded by someone who's carrying out the spirit of the program a little better.

Now, this is not to say that TVA was preaching or ever preached: "Use electricity and waste it." They'd rather preach: "Use electricity wisely; use it to the best advantage--it's a good tool." So far as I know, it's still the program.

CRAWFORD How did you change people's minds about things like that--about the use of electrical heating?

CHAMBERS Well, some of them were changed because, you know, time is a great help on all problems, I guess. And as time passed and some observations of the experiences that other distributors were having--successful experiences--they simply changed.

It was generally not sudden; it was evolving. And then there were one or two whose minds never changed. This one that I'm speaking about retired and was succeeded by someone who accepted the desirability of electric heat. I know this doesn't sound so impressive to you, but you'd be amazed at the power of persuasion, and sometimes it came from two ways. It came from TVA, and it came from their retail customers who lived in this area, who were discouraged from using electric heat, but they had some friends who live over in the next county or lived someplace else who are just delighted with electric heat; and they come back home and say, "Why not us?" So the pressure comes really two ways.

CRAWFORD Do you feel that you were making progress in this division? Were you getting the things done that you wanted to while you were working at Jackson?

CHAMBERS Oh yes, sure. There were always problems occurring, but there were always ways to deal with them and most of the time it took a little pulling together. If we needed to do something in a certain place, then the operating people could arrange for this to be done or whoever else was involved. Yes, it worked fine.

CRAWFORD You had a continually increasing power usage, I suppose.

CHAMBERS Yes, we certainly did. I don't really know what it was then. It was an evolving thing. Today the residential usage in the TVA area, as I recall, is about two and a half times the national average. In the beginning when TVA first extended its service,

or its distributors did, into the rural areas, the rural usage particularly was low because, gee, these people have never had it before. To some of them, why having a light in each room was just fantastic--that they could go and turn a little button on a drop cord. They didn't have to carry a lamp around. And I think that the first things that were used would be one light in each room and then the electric iron. The electric iron was perhaps the first appliance that was used. Well anyway, in those beginnings the annual consumption was very low and I don't know what it was. But there were a lot of smiling faces; I can tell you that.

CRAWFORD Well, this was one of the greatest developments for bettering human living in the area.

CHAMBERS Sure. This is right.

CRAWFORD What about the establishment of electric cooperatives for the rural areas unreached. How did you encourage that?

CHAMBERS Well, I'm not sure that TVA can take credit for the establishment of rural co-ops without recognizing that the REA was the financing agent for most of them. Now, the REA didn't finance all of them. You see, the way electricity came about, as it did, was for service to be provided to communities and cities first. The provision of service out to rural areas is something that's expensive per customer, so you had a question here of if you extend service out, then there'll be more houses and there'll be more usage,

but you first have to extend the service out there. REA came up with a program of providing funds at low interest rates--two percent. This helped to reduce the annual cost to get over this difficulty of extending facilities of high investment per customer. If you only have three or four customers per mile, in contrast to in the city, maybe you have twenty times that many per mile or something; you can see that the investment is much higher per customer. REA provided these funds, I think beginning in '34--was it..

CRAWFORD The date sounds right.

CHAMBERS And so this worked wonderfully with the TVA program.

They'd provide the distribution the same as is provided in the cities, and TVA would supply them with their electric requirements at designated load centers. Now sometimes a division of distributor's identity occurred here, which I think was fundamentally not good. I think that a given area should be treated unto itself, and what's good for that area or any piece of it, is good for the whole area. For example, a county can have a county seat and some other communities. If the rural area surrounding them is getting along nicely, then they'll get along nicely, and vice versa. Now, as I just said in the character of electric service, the cost of supply to the rural area is generally greater than in the urban area, so what you need is to package this together to where one system will average this cost. Instead of having a system in this county for, say, the county seat or an urban area and then another one for the rural, I think they ought to be together. There are economies in operation, there are economies in

planning, and there are many economies that can be taken advantage of by operating together.

Now, that's not the way that many of these things begin. There's been a little bit of progress, I think, made. For example, to illustrate the way I speak, Lincoln County, Tennessee had an electrical system. The county seat named Fayetteville also had an electric system. They had some duplicate organizations, and they had a lot of things that could have been carried out more economically if they had joined together, and you know what they did? They joined together. And I just think that this is real good. I think it would be good if instead of 160 distributors that TVA may have, half that number or something that would be economical. Now this is what power companies do. Power companies supply an area, and they have rates, and the rates are averages.

CRAWFORD Was any attempt made to do that--to combine these?

CHAMBERS Yes, there were, but local politics get to be real inhibitive. It's childish and silly, but it's true that there can be some jealousies. Say, here's a county that has a county seat--now this was not true of Fayetteville and Lincoln County--but there can be a place where the county seat is jealous of another community in the county. Now they just won't join with them. They just won't have a joint effort to combine their electric system.

CRAWFORD How could that be dealt with? Could TVA provide some sort of incentive for a combination?

CHAMBERS Yes. Well, TVA can't provide incentives for any special rates or anything of that nature, but the incentives are available as I've just said. If, for example, an electric system in the county seat and an electric system for the remainder of the county would join together, they could take their electricity requirements through a lesser number of metering points so that they would get a lower power and energy cost from TVA. In addition to that, they could combine their forces so that they only have one manager and one office and one bookkeeper; and while you probably could not halve the service people, you could certainly reduce the people and the equipment, and you could have common dispatching. And there are some real economies available here, but you have to recognize that this can be done only if the respective boards of these systems agree to combine.

CRAWFORD Has that sort of saving been pointed out to them?

CHAMBERS Oh, yes. In fact, there's been a little bit of regression in that problem. There have been a couple of new distributors created. And to my mind, it's not been good. The piecemeal operation is just simply not as good.

CRAWFORD What other work did you do in your position at Jackson, Mr. Chambers?

CHAMBERS Well, that was about it. It was field testing. And in May of 1941 I moved down to Tupelo, Mississippi as a District Operator Superintendent.

CRAWFORD Were you glad to make that move?

CHAMBERS Yes, I think so. I wasn't glad to leave the place that I left, but I was glad to go to the place that I did because it sounded like fun and it sounded exciting. And that's the way it turned out, because I arrived there at sort of a critical time when in the early summer of '41 there was a rainfall deficiency in the valley that had resulted in a critical condition for hydro generation. And this was aggravated by the fact that the nation was attempting, among other things, to produce as much aluminum as it possibly could for war effort. And so about the time I arrived in Mississippi or a few weeks afterwards, the effort was made to find electric energy anywhere it might be found at any cost it might be found.

So in north Mississippi, in the Tupelo area where I went, there were small communities that in earlier years had little local generating plants. They were located at Amory and at Okolona and at New Albany and at Water Valley, and then TVA had taken over some small plants at Tupelo and at Corinth, and then there was a small isolated plant running at Oxford, and in all cases the effort was made to try to get these things running again. So the word was passed, "Do anything it takes. Just get these things connected if they can be and running if they can be." So I was involved with the effort to do this, and there were units that hadn't been run in so many years that the deterioration was bound to be bad. If we had tested them thoroughly, we wouldn't have had enough nerve to start them, I guess. But we did some elementary testing. We started them. We paralleled them with the system, and some of them were just little tea kettles, but they made

electricity. And the cost was high, but we had these little things running all over the place. It upset our automatic relays. We had to pay in a lot of different ways, but we did, and we got the electricity. And this was just a heck of a lot of fun to get into this program. They continued running for a pretty good while. It was the war effort.

CRAWFORD And that released your regular supply of TVA electricity for war plant work?

CHAMBERS Yes, this is right. It was by substitution. Every kilowatt hour generated in Mississippi by these little things released some to go to the aluminum company in east Tennessee and north Alabama. You see, aluminum in those days took about nine or ten kilowatt hours per pound. It could now be down maybe to say eight, but one of the principal inputs to making aluminum is electricity, so that's what laid behind finding the energy.

CRAWFORD Was this program carried out throughout the valley as well as just in your location?

CHAMBERS Oh, yes. But Mississippi was sort of at an extreme end of the TVA system--kind of a tag end--and so far away from headquarters that we didn't get the supervision. We were just told, "Do this and get at it," and we did. There were other sources of energy that were all over the system that were also gotten into operation.

CRAWFORD Do you have any idea how much saving that made in electrical use for war work?

CHAMBERS No, I really don't. Now, the part that was in Mississippi couldn't be called significant, but every bit contributed. It's like the widow's mite, I suppose. Also TVA in those days, here again by persuasion, encouraged people to not use electricity for nonessential purposes, and that was generally successful. There was one instance in Memphis, I think, when Brother Crump wanted to keep his athletic field lighting on, but the general outcome was that people did cut back on their use of electricity.

CRAWFORD That was a real change, wasn't it, because until that time you'd been encouraging people to use more electricity; then you had to reverse it.

CHAMBERS Yes, that's right. But it was clearly explainable and understandable.

CRAWFORD Yes, I would think so, and I would believe you had no difficulty persuading people to agree with that.

CHAMBERS The only one that I know that got mad at us was Crump, and McKellar got mad at us. The other side of that picture is that TVA also expedited added generating facilities just as fast as it could.

CRAWFORD That was a time of great construction.

CHAMBERS Yes, it was.

CRAWFORD Why was Senator McKellar angry? Was that related to the Crump feeling?

CHAMBERS I think so. I don't know if you want to put all of this in records or not, but Senator McKellar was basically a politician. And he really wanted to have a little influence with TVA and maybe its employment, and he also was obligated to do Ed Crump's bidding. And Crump was a prima donna who wanted to tell TVA what to do, and as I said in the beginning, one of the most delightful things about TVA is, by golly, the politics are simply not here.

CRAWFORD And that must have been frustrating to many politicians because they weren't accustomed to that.

CHAMBERS It was. This is right, and McKellar was a politician. He couldn't get over it. In fact, he had a few relapses, I guess, as time passed.

CRAWFORD During the time you were at Tupelo, of course, the war was on. What other work did you do at that time as District Operating Superintendent?

CHAMBERS Well, it was the routine operation and maintenance of the transmission system and the emergency operation and maintenance. This generally means that there is a transmission system composed of lines and substations that must be inspected periodically to be assured that they are operating all right, and this is carried out by crews of men who patrol the lines, and they note the defects

of woodpecker holes or structures that have been struck by lightning and damaged, insulators that have been damaged by lightning or gunfire or whatever, and the substations that must be checked to be assured that all of the equipment and all the facilities are in good operating order. This is a routine thing that was carried out under my supervision. And then we had emergency events. Sometimes it would be a tornado that would take out certain facilities and interrupt service, and then we tried to make repairs as promptly as possible--get service restored.

You're aware of what depends on electricity in hospitals and firefighting and water pumping and communication, and you can't even get gasoline from a service station without it. Then there were events that occurred for other purposes. Sometimes an airplane would crash into a line. Sometimes a forest fire would set poles on fire or grass fires, and I was responsible for the operation and maintenance of the system of the Tupelo district.

And some of this, both routine and emergency, required coordination with the distributors where we would go to a distributor and say, "We have found a transformer in this substation that needs some repairs; it has something that needs to be done. So we would like to have an interruption to your service to place the spare transformer--connect it for service and disconnect the one we want to work on, and that going to take us "X" minutes." And he would review his hospitals and his radio stations and his significant loads, and he would come back and say, "Well, you can have that from 12:15 a.m. to some time on some date." Now this was all persuasion. Nobody was dominating anybody else

here at all. Sometimes it would relate to the transmission lines. In the beginning these transmission lines were many one-way radial feeds, and if lightning struck a structure and left it in such hazardous shape that we wouldn't work it energized--work it hot--in that fashion with reasonable safety, then we had to get it out of service. Sometimes it was such an emergency that we had to call and say, "We're having to disconnect this." Other times we could call and say that we need to do this just as soon as we can, and so we'd arrange a time. But it was always working with the distributors, and then they had problems at times that they consulted TVA about. And if either one had something in the way of a problem that required an interruption, then the other identified work that he might do while the interruptions were going on anyway.

CRAWFORD What sort of problems would they have?

CHAMBERS Well, they might say, "I have to build a new circuit from your substation, and I have to connect that circuit in this fashion, and I'm going to have to interrupt the service to do this." And we would say, "Well, while you're interrupting this, we're going to do this work in the substation which we need to do. It's not an emergency, but we need to correct a condition here." Maybe some insulators had been broken or something, so this would take advantage of the service interruption that was required anyway. Generally you made a list of things that needed to be done with the priority established.

And then in those days the patrolling of transmission lines was carried out by foot patrols. This is where a vehicle would drive to a point and let a man out, drive to another point and let another man out, and these men would patrol up to the end of their designated sections and pick up a vehicle and leap frog. Then as this work was done, the men would patrol different sections each time so as to become familiar with the terrain and all the characteristics of each and all of the access roads. And as a matter of fact, they got acquainted with the farmers along the way. And so then when what's called a case of trouble occurred--when an emergency arose--the men could go out there and say, "Well, we know these folks." They might even go by the farmhouse and say, "This is Joe with TVA. I've got to get in your field and get a pole replaced or do something." And the farmer would have his knowledge and confidence in Joe, and he'd know that if Joe damaged his crop with his truck that he'd be paid for it, or if he broke down a fence or farm bridge, that he would fix it. I mean, this is one of the things that's lost with the air patrols today--is that relationship with the people. And then the farmers all felt good towards TVA--or almost all of them in those days--because right before them in their generation they had been provided with electricity which they hadn't previously had.

CRAWFORD Of course, that was very important then. They understood the problem with being without electricity.

CHAMBERS Sure. Today it's different. It's some generations later, and they're generations that know nothing about anything before TVA was here. And they accept it, they demand it, and it's an entirely different view that they have.

CRAWFORD But TVA had very good public relations then, didn't they?

CHAMBERS Yes. And they still do, but I'm just saying that the TVA image is a different thing to today's generation from what it was to those who were present when much of TVA's area coverage accomplishments occurred.

CRAWFORD Did you have personnel problems in this time? With the war on, were you able to get the men you needed to do this work?

CHAMBERS Generally so, I think. We lost a lot of people to the war, but there was a classification system, you know. As a matter of fact, I had trouble getting in the Navy, because I was classified something--I don't remember what it was--that I was doing essential work. Now I was working for an identified critical industry and I had a job that was essential. So when I applied to the Navy, the first thing I had to do was get a release from the draft board, and the draft board wouldn't do it until TVA wrote them a letter and said that they wanted to cancel their previous request that put me in this deferred status. It took me a few months to get in the Navy.

CRAWFORD That was in February of 1943, I believe.

CHAMBERS Well, I started, oh, a couple of months after Pearl Harbor. Joe Harrison and I, both in Tupelo, went down to New Orleans, and we went to the office of Naval Office Procurement. And they said, "What do you want?" And we said, "We don't know, we'll

tell you what we've done, and you tell us what the Navy has to do that we could help out with." And the fellow looked at me and says, "We can make you a J.G.," and I said, "What is that?" And Joe looked over at me, and he said, "I don't know either." But one of the things was that TVA wanted somebody to take my job over, and they wanted a phasing to be carried out. There was a fellow named A. P. Brazelton who worked for TVA in Tupelo who was going to be made the District Operating Superintendent, and it took a phasing operation to get Braze acquainted with everything and the status of everything. This is understandable.

I don't think TVA suffered from lack of manpower due to the war. I think where they needed it, they got it. That's not to say they had everything they wanted, but TVA's never been one, I think, that had to have every damn thing it wanted just so, you know.

CRAWFORD So you left Tupelo then and entered the Navy, and you were doing minesweeping work. Was that related in any way to your engineering background?

CHAMBERS Yes, it was. I think I was pretty lucky about this.

Many people went into the Navy and got assigned things that were just completely foreign to what they'd been doing, but minesweeping generally involved a lot of engineering and a lot of electricals, because there are two kinds of mines. There are contact and there are influence type mines, and the influence type are generally acoustic and magnetic and pressure, and they operate-- and also their minesweep gear operates--using a lot of electrical principles and equipment. So I think that I got a pretty lucky thing. Now a minesweep is not exactly choice duty. They are small ships, and they have a lot of problems associated with them, but I think on the balance I did all right.

CRAWFORD You seem to be more related to your professional work than many, I'm sure.

CHAMBERS Yes. I came back from the Pacific Ocean and went to work January 1, '46 right back to Tupelo.

CRAWFORD And did you return to the same position?

CHAMBERS Yes, I did. I couldn't find a place to live, and I was miserable, and finally a fellow in Tupelo built me a house. A week or so after we moved in--we hadn't even gotten a front door yet, because that was among the things that were not available right after the war--I was asked about going up to Jackson, Tennessee as Assistant Division Engineer. And I responded, "I'm not interested, because I've just found a place to live. I've thought about that now for a long time and I want to live normal again. I don't want to get into house hunting and living in hotels again." But I went up there and talked to them, and there was another fellow they were talking to at the same time for the same job named Roy Dionysius. Roy's in Chattanooga now and I don't know if you've talked to him or not.

CRAWFORD No, is he retired now?

CHAMBERS No.

CRAWFORD Usually I talk to people only after they've left TVA.

CHAMBERS I see. Well, the folks in Jackson didn't make their selection for some time. Anyway, I got back to Tupelo

delighted that they hadn't, and delighted that I wasn't it. The next day came a call from Nashville; Earle Wall wanted me to come to Nashville. And the Division Manager in Tupelo named Earle Baughman, who has retired, and maybe you've talked to him.

CRAWFORD No, sir.

CHAMBERS Well, if you haven't talked to him, I think he'd be a good one to talk to if you want to make a note of that. He encouraged me to go to Nashville, and I went up there.

CRAWFORD Excuse me, sir. How do I spell his name?

CHAMBERS B-a-u-g-h-m-a-n. Earle Baughman. And it's possible that you would want to have Len Seeber to make the arrangements, but you can tell Len that Earle's first hand knowledge of some of the earlier arrangements with distributors is excellent.

Anyway, in August of 1946 I went to Nashville, and I was Assistant Division Engineer. And as I said earlier, it was something of a continuation of what I was doing in Tupelo, except to a greater extent, because the Central Division, with headquarters in Nashville, involved three operating districts. So there were more lines, more substations, more men, more responsibility, more going on--a tremendous amount of construction work--you know, the backlog that had accumulated--and in character, though, it was not greatly different. You know, it was thought that when the war ended that the electric load would go down, and it did go down slightly for a short time and resumed its trend back up. So during the four years that I

was in Nashville, they were very busy years in operating and maintaining the transmission system and substations and providing for the massive numbers of arrangements that had to be made for every weekend and many nights to put the system in an abnormal posture to allow work to be done in certain places that had to be done. There was much of it that was a sequential nature thing. There were major voltage changes in certain areas. That was a busy time, and it was a lot of fun.

CRAWFORD It was a busier time than Tupelo, wasn't it?

CHAMBERS Yes, it was. But it was just a heck of a lot of fun.

CRAWFORD Who took your position in Tupelo when you left?

CHAMBERS A fellow named Penn--John B. Penn. He's still working for TVA.

CRAWFORD Where was Earle Baughman at this time?

CHAMBERS He was in Tupelo. He was Division Manager for the Mississippi division in Tupelo.

CRAWFORD Has he retired in Tupelo?

CHAMBERS Yes, he has. He's the man that I suggested you might get Len to arrange for you to meet.

CRAWFORD Let's take a short break.

THIS IS THE ORAL HISTORY RESEARCH OFFICE OF MEMPHIS STATE UNIVERSITY. THIS PROJECT IS "AN ORAL HISTORY OF THE TENNESSEE VALLEY AUTHORITY." THE PLACE IS HOUSTON, TEXAS. THE DATE IS MARCH 3, 1972, AND THIS IS INTERVIEW NUMBER THREE WITH MR. FRED CHAMBERS. THE INTERVIEW IS BY DR. CHARLES W. CRAWFORD, DIRECTOR OF THE MEMPHIS STATE UNIVERSITY ORAL HISTORY RESEARCH OFFICE, AND WAS TRANSCRIBED BY MRS. SHARON C. HESSE.

CRAWFORD Mr. Chambers, let's deal now with your work at Nashville, then we'll continue to Chattanooga.

CHAMBERS O.K. As I explained, the work in Nashville was in the same general character as what I did in Mississippi. At Tupelo I was a District Operating Superintendent, responsible for the operation and maintenance of the transmission system in that district. When I moved to Nashville as Assistant Division Engineer, I had responsibilities of the same general type; that is, the division was made up of three districts, each of which had an operating superintendent and the necessary crews of men to carry out their jobs of operation and maintenance of the transmission system in their districts. They, in turn, reported to the Division Engineer, whom I assisted and helped to coordinate the efforts and establish practices and in cases of emergency provide assistance from one district to another. The general character of the work, however, was about the same

except the operating superintendents were directly supervising and in this case, I was not an operating superintendent.

The magnitude of the work in the central division in Nashville was very great. The period from August of '46 to August of '50, when I was there, was a time of great activity resulting from the backlog of work on the transmission system that had accumulated during the war periods. There were major changes made. There were voltage levels that were changed in certain areas. Every weekend was very busy, because this was a time that the system could be arranged in an abnormal posture in order to carry the load during a time that certain major facilities were being taken out of service in order to make the revisions. And some of these things were required to be sequential in nature to the extent that many of these weekends we started when the load began to come up again on Monday morning as daylight approached. It was a lot of fun. There was a lot that went on, and it really was accomplished in a real effective manner.

You'll recall that immediately after the war it was thought that the load would go down, and it did, but there was just a relatively small dip and then it started its path back up again. So most systems had their hands full after the war ended.

CRAWFORD And your work was basically similar to that at Tupelo, wasn't it?

CHAMBERS Yes, that's right. It was similar, except there was a whole lot more of it. It just hit at this real heavy scheduled time.

CRAWFORD It sounds as if you had irregular working hours.

CHAMBERS Yes, this is right, and as I say, it was a lot of fun. It wasn't all easy, because it just turned out that the winter of '46-'47 was a fairly severe one, and I recall that we had a sleet storm during that period that affected a good bit of the transmission system in the general Estill Springs, Shelbyville, Columbia area where we were trying to get some sleet melting established on the 46KV system through that area. And we kept some of it up and ice free, but a good deal of it went down and they had a fairly extensive period of work to put it all back up. You know, a sleet storm can be the most devastating thing on a transmission system, because it can affect extended areas where the ice builds up on the conductor and then the weight breaks the conductor or the structures or both. And a tornado, on the other hand, has a fairly narrow path. It's very devastating, but it doesn't cover anything like the area that a sleet storm does.

Well, anyway, during this period also there was a fairly major flood that occurred to flood out the Columbia primary substation. We had the Duck River at that location--Columbia, was out too--I think, the greatest flood on record--and we had quite an exciting time of keeping the system operating there. All in all the work in the central division was anything but monotonous. The Central Division Manager was Earle Wall, and the Central Division Engineer was Ralph Sanderford. Ralph, by the way, had retired, and he's in Nashville. I don't know if you'd want to talk to him.

CRAWFORD Probably so. How do you spell the name, sir?

CHAMBERS S-a-n-d-e-r-f-o-r-d. And if you got into the power system operation--the field operation--he might be one you'd want to talk to.

CRAWFORD What was his position then?

CHAMBERS He was the Division Engineer. I worked for him.

CRAWFORD At Nashville?

CHAMBERS Yes.

CRAWFORD And his first name was Ralph.

CHAMBERS Ralph, yes--R. B.
I think I've about covered all the work in the central division unless you want to expand on some of it somehow.

CRAWFORD No, sir, I believe we're ready to go on to Chattanooga in 1950.

CHAMBERS Well, in the summer of 1950 the Chief Power Engineer, Merrill DeMerit, asked me about interest in coming to Chattanooga as his assistant. Now this concerned me a good deal, because you'll recall that I got out of school in 1930, and most of the time during that 24 year period I had not been involved in the complex system planning type of work that the Chief Power Engineer, was responsible for. That's to say that in operation and maintenance

you accept what's there, and you use it to the best advantage, and you try all the tricks to make it work in ways that you need it sometimes and to carry a load under abnormal conditions. But the detail engineering studies were the kind of things that I was real rusty on. But anyway, even with the apprehension, I took it and I went to work for the Chief Power Engineer in August of 1950. And there I arrived at a time that things were beginning to get real busy.

Planning the bulk power supply system for the TVA and the power and energy requirements of the 160 distributors is a rather complex kind of a problem for the transmission system, because this arrangement is a little like a marriage, and the interest is in what's good for the family or the combination of the two. And this is to say that transmission planning should be carried out so that TVA would not spend an excessive dollar for the transmission in order to save a distributor a lesser amount for his distribution facilities and also the reverse of this. We were, therefore, seeking the most economic combination of transmission and distribution, and then the engineering solution would be the proper one.

This, however, resulted in a considerable amount of conferences and joint studies between TVA and its 160 distributors. And so, if you recognize the magnitude of load growth and the need that arose with some of these distributors to meet more than once a year, you can see how many meetings were going on each year, and how many studies were going on. And the number of dollars that were dealt with in these studies were also very large, because TVA's transmission cost, I think, could be in the order of \$50 or \$60 a kilowatt, and the

distributor's cost of distribution facilities can run some perhaps \$125 a kilowatt. The sum of the two is not far from \$200 a kilowatt average--and I'm just getting these numbers, now, off the top of my head--but if you consider the load and multiply this by \$200, and if you're going to increase the load a million kilowatts, which is not very much of an increase percentage-wise, then you're talking about \$200,000,000. And so the studies were very complex and very important.

In addition to this, there were the studies necessary to be assured that the generation was introduced to the system in the most economic manner that would provide for reliability standards, and even in those days we didn't intrude on the environment without some thought.

In addition to this, the service that TVA provided to the directly served industries resulted in some considerable engineering problems that were of a magnitude that had not ever been encountered before. During the early fifties, for example, the AEC began a program of increasing its operation at Oak Ridge. They set out to construct and ~~did~~construct their Paducah facility.

The interesting thing about Paducah, for example, is that they planned to put in a million kilowatts of gaseous diffusion enrichment facilities. Half of this amount was to be supplied from TVA at a steam plant that it would build for this purpose. It was named Shawnee, with ten 150 megawatt units. The other half was to be supplied by a group called E. E., Inc., who built a plant for their purpose at Joppa. It was composed of six 165 megawatt units. And

the studies required to determine the engineering parameters, the design criteria, the unit characteristics, the transmission connections-- and all these things were very complex, because of the limiting features that were encountered in a lot of equipment, such as switch gear. And while these were going on and some plans had begun to emerge, AEC decided, well, we'll just double this thing and make it a two-million kilowatt operation. And it was arranged that TVA would supply three-fourths of the second and one-half of the first, so this made TVA supply five-eighths of the combined operation, and the work went forward. But here the problems associated with it were considerably increased and complex, and we just taxed the whole electric manufacturing facilities in the United States to get the equipment required to do this job. Then at Oak Ridge the massive increase at that location was supplied completely by TVA.

And then another thing that's of interest is the AEDC U. S. Air Force facility that was installed near Tullahoma, Tennessee. This facility, while the load is not nearly as great as the AEC, had some characteristics that were most difficult to deal with. For example, they had a wind tunnel here which was driven by a shaft on which there were two 25,000 horsepower and two 83,000 horsepower motors. Provisions were made to add more motors as they wanted to do this. As I recall, the inertia of this mass at that time amounted to about one-seventh of the total inertia of the TVA system. The problems came about because of the working out of ways to start this facility without undue shock and undue voltage dips. And then in those events when the specimen failed and the facility was shut down

suddenly, there had to be some adjustments to TVA's generating output to bring the tie line loads back to schedule, and this needed to be done promptly.

Well, one of the interesting things which is also memory now: the shaft, as I recall, with the four motors would, under full load arrangements, have a twist. This shaft was about 40 inches in diameter of solid steel, and the twist in the shaft amounted to about seven and a half or eight degrees. Now this translated to the motors resulted in an electrical twist of about 27 or 28 degrees, and this means that anytime that this thing was tripped off suddenly the first thing that happened to the motors was that they would speed up, because the twist in the shaft would speed them up. So there were some interesting problems there, and they were a lot of fun. And I learned an awful lot due to my participation in all the planning that went on with TVA's distributors and with TVA's Office of Engineering Design and Construction, who built the generating plants, and working with the consulting engineers and the owners of facilities that TVA supplied direct--AEDC, AEC, large aluminum plants, and things of that nature. It was an exciting place to be, and the ten years association with DeMerit were a real opportunity in a career.

CRAWFORD That's D-e-M-e-r-i-t?

CHAMBERS Yes. He got it spelled a lot of other ways, and he didn't like it when somebody misspelled it. He was a kind of a prima donna--there's no question about this--but he was

real tops in competence in electric system planning and getting the grasp of the problem. It was a real opportunity to work with him. That about covers what I did with him.

On his retirement I went to work then as Assistant Director of the Division of Power Planning and Engineering, as I indicated earlier, and this division was composed of five branches. The total number in this division was about 425 people or something like that, most of whom were the engineers. There was a branch of Transmission Systems Planning that had responsibility for planning the transmission system and the connections and arrangements at generating plants. The Electrical Engineering and Design Branch had responsibility for designing and engineering the substations and the electrical facilities that the transmission systems planning group prescribed. The Civil Engineering and Design Branch was responsible generally for structural designs and engineering and for transmission lines. The Communication Engineering Branch was a combination of planning and designing engineering. They did both of these functions. And communication here is in its broadest term. It does not only mean voice communication, but it means the communication of all the data and intelligence that's required to go back and forth on an electric system to make it work. For example, much of the automatic relaying requires two ends of a line maybe 100 miles apart to be compared to see what the readings are before the decision is made to open switches or to not open switches. And this is to identify faults that may be differential or between the two, as discriminated from faults beyond one or the other.

Then there's the Branch of Power Supply Planning that was in that division at that time, whose responsibility was to make all the studies and economic analysis required to recommend the power supply program--when, where, what size units to add--and they were also responsible for analyzing all of the contractual provisions with neighbors that provided for our achieving economies by transactions with them.

I think one of the outstanding things that occurred during this was the development of the seasonal interchange arrangement between TVA and the South Central Electric Companies lying to the southwest of Tennessee. Now has somebody else already covered this part?

CRAWFORD No, sir.

CHAMBERS Well, TVA system peak load occurred at that time, and it still occurs, in the wintertime, and it's expected to continue this for the foreseeable future. This is the TVA natural system load. The wintertime load, as I recall, was on the order of three and a half million kilowatts greater than the summertime load. There was a combination--a group of systems lying to TVA's southwest called South Central Electric Companies, who had collectively almost the same size load that TVA had, but its characteristic was just the reverse. Their peak occurred during the summertime, and it was about the same amount, so collectively there seemed to be an area here that some considerable tradings could be achieved. And what we did was to develop an arrangement, and it was built up over a period. But in substance TVA would supply 1,500 megawatts to the South Central group

in the summertime during the identified period of weeks which was established. In return for this, they would supply TVA 1,500 megawatts during the winter period of a like number of weeks. It would be a trade-off.

CRAWFORD Who thought of that idea?

CHAMBERS Well, I think TVA thought of this, and we proposed it.

And it didn't get accepted in other areas, because there is a posture of public versus private. And this came not too long after some hassling had gone on as the carryover from Dixon-Yates, which was an effort of the companies to the southwest to build a generating plant across the river from Memphis in Arkansas. And it's a long story, but the friendly spirit is not exactly there. Also, I think that some of the companies to the southwest, after this got going, were inclined to take some credit for it, and I don't know that that's something to make a big debate over. The main thing is that we found a way to work together and identify the economies and to carry it out.

Now I want to illustrate just what this means. This 1,500, by the way, was the main thing involved, and there was a contract developed--an interconnection agreement--to do this. The agreement was developed between TVA and the Mississippi Power and Light Company, because it takes an entity to have contracts with, and South Central is not within itself a contracting type of an entity, so Mississippi Power and Light represented the others as the contracting one. But this contract has schedules, and the main schedule--the most

valuable schedule, I suppose--is the seasonal interchange. Now just think of this a minute. They are able to permanently--perpetually--delay 1,500 megawatts. TVA also. The sum of the two is 3,000,000 kilowatts. If its costs you \$200 a kilowatt to install it, that's \$600,000,000 that the two organizations are able to perpetually delay. Now, of course, it cost something, but its costs were very small compared to the benefit. The cost was represented by the 500KV transmission lines that were constructed to provide the transmission capacity to carry this out. Now the arrangement is that each company treats the 1,500 as firm power obligation on its part, with the status and stature of the firmest power they supply on their particular system. In other words, it's a very firm, solemn obligation that you can hang your hat on.

CRAWFORD And this was made because in the TVA area heating was large in the winter; in the southwest, air conditioning was large in the summer, I suppose.

CHAMBERS Yes. And it's expected to continue that way. But the real important thing is that each party is able to rely on 1,500 as though they had put in generation, so they put in transmission adequately to do the job and to provide reliability.

CRAWFORD That saved a great deal of construction costs, didn't it?

CHAMBERS Yes, it did, but the transmission was a fairly substantial job. This exchange was scheduled to begin in the spring, May 15, 1965, and the transmission program was just full of difficulties that would make a long story unto itself. It got in to meet the schedule, but there was no time to spare; it was a considerable effort on

everybody's part. It was the first 500 KV transmission facilities in the whole United States--in fact in the whole free world--that went into service on a regular scheduled basis to carry a large amount of scheduled power and energy. Now these words are real important, and the reason they are is that 500KV test facilities had been installed before in the United States, but this was the first real full scale application that was relied on.

Also, there was another 500KV program going on in the United States at the same time by the Virginia Electric and Power Company, who had a contract with Westinghouse and with Stone and Webster for 500KV transmission facilities to be used to transmit the quantities from the Mount Storm generating plant in West Virginia into the VEPCO facilities at Waynesville and Richmond, but those facilities didn't go into service until the fall of 1965 on any basis of need because the generating units didn't get going until then. They made some claims of having energized the line a day or so ahead of TVA's, but it could only be used for supplying some construction power back to Mount Storm.

And during the period that this was going on I was hoping that VEPCO would energize their 500KV first. It would be distasteful to me to think of TVA spending an added dollar for an image. In other words, I would rather somebody would energize first than to have a question about did we spend any money needless for an image. But the facts are that TVA had the first, and we made some footprints, and the engineering fraternity of the United States and of the world took their hats off to us. All segments, public and private, called us many times inquiring about what we were doing, what we'd learned, what we knew,

and what we didn't know--and there was a lot of both--and we shared these things. And we, I think, had the respect of the whole world--this included the Russians, by the way--in what we did. Now I'm proud of the 500KV and the way it went in.

Now, in addition to the contract providing for the seasonal exchange of power, which is the most valuable, the contract has schedules also for other things like economy, power, emergency assistance, just straight out sales, etc. Do you know what economy is?

CRAWFORD You'd better explain that, I believe, Mr. Chambers.

CHAMBERS Well, economy means that the TVA system, for example, who's load dispatcher, has a right to call the neighbor (in this case South Central) and say to him, "What is the incremental cost of power and energy delivered to us beginning at a certain time, say 4:00 p.m.?" He has no right to do this, unless he has alternate sources available on TVA's system. That is, this is strictly economy now. The other dispatcher may respond, "Well, I only have 100 megawatts, or I have 300 megawatts that would be available at three and one-half mills a kilowatt hour. What is your worth of this? What's your alternate?" The TVA dispatcher could say, "Well, my computer tells me that my alternate cost would be four mills a kilowatt hour, so I want to buy 100 at three and three-quarter mills." That is, we just share the savings. Now this is if, as, and when, and it's up to the system to define in each case, and the economies are not nearly as great as the seasonal exchanges. That's the big thing.

Then another thing is emergency assistance. This interchange agreement has a number of schedules, and they can be added to, of course. I think that this agreement has been viewed by the industry, and there's some admiration for the cooperative manner in which this was carried out.

Well, this was in the Power Planning and Engineering Division while I was Assistant Director from '60 to '63, and while I was Director from '63 to 1970. It illustrates the kind of work we were doing, the magnitude, and you can't say anything to illustrate the blood, sweat, and tears that went on to make it work, because that effort--you could write a book about how we got the first 500KV installed and ready to be energized a couple of days before the contract called for it. And then the second bit of it was in the summer of 1966, was available for service 13 minutes before midnight of August 15, 1966, and the contract said August 15. So we had 13 minutes to spare. Everybody involved with that made memories that will stay with them.

Then in January of 1970 when I moved to be Assistant Manager of Power, there were some changes made and this Division of Power Planning and Engineering was divided into two parts. It became Transmission System Planning, and it became Power Supply Planning--two divisions by those names and two directors. The Power Supply Planning had gotten considerably overwhelmed with the workload, because of the magnitude of the generation planning and the studies required and because of the many problems that emerged in connection with the AEC licensing requirements for the nuclear

plants and for the environmental requirements for all plants. Because of these delays, it turned out that a lead time of six or seven years is about what has to be faced right now. And if I remember right, TVA now has about 16,000,000 or more kilowatts of additional generating capacity now in its pipe line.

If you think about this a minute, though, you'll recognize that kind of problem, because if TVA's system load is now sixteen or seventeen million kilowatts, and if the reserve requirements are such that to achieve the reliability that they want or had determined, it takes 20,000,000 kilowatts--now I'm just using round numbers now--and then if I should say that the load doubles in ten years--now I don't know this and nobody does now, because historical projections may or may not be suitable for use--but let's say that it doubles in ten years. Now this is not an arithmetic increase; it's an exponential. In other words, in seven years from now you may have to have 80 percent as much generating capacity added as you have now. So seven years from now you have to have in your program 80 percent of 20,000,000--is 16,000,000, so this is about right. And the problem is that the studies required to be carried out to develop the program have to get started substantially previous to the time the board approves the project. In other words, when you set your time, it is from board's approval to commercial operation, and so the studies turn out to be eight and nine years maybe ahead. Well, you're just projecting habits of human behavior beyond what is clearly discernible to you. And so the power supply planning

program is a big thing; and one of the biggest parts of it relates to environment and then to licensing. There's a big nuclear staff, for example, that I don't remember--maybe 40 people, many of whom are physicists that are dealing with the technical problems associated with it.

CRAWFORD When did you start that aspect of it?

CHAMBERS Well, we--I don't know exactly how to say when we started it. We really got started in nuclear with an experimental gas cool reactor program that AEC established up at Oak Ridge, and TVA participated extensively in that operation. Bud we had nuclear studies before--for a decade now. Now, of course, there's Brown's Ferry with three large units and Sequoyah with two large units that are under construction. There's Watts Bar that is getting going with two large units. There's another one that I don't think has been identified yet--maybe it has--that will have two large units. And it's an extensive program.

Well, anyway, they divided into two divisions; and when I went up to be Assistant to the Manager of Power in January of 1970, I found myself with some continued overview of those responsibilities and some more. I'm not sure that I can add much to the work that I did as Assistant Manager of Power, except I tried to help Jim Watson all I could in taking part of his load, especially the engineering part.

And we had a terrific amount of involvement though--time consuming involvement--in working with other people. And I

mean by this that there was a thing established called the National Electric Reliability Council, NERC. It came into being, I think, in an effort to demonstrate that the electric system in the United States could accept the responsibility that they had of providing reliable electric service. It was made up of twelve entities, but it's now made up of nine. They're called councils, and in the beginning TVA was a separate member, but now TVA is a member because of its membership in the Southeast Electric Reliability Council called SERC. SERC has meetings and NERC has meetings--all kinds of work goes on, hopefully to provide assurance of reliable electric service. Then there's a thing called the Electric Research Council, which hopefully will provide a means for carrying out the research required for the electric systems to be able to do its job in an economical and satisfactory way.

I was on the task forces and the committees of these various things, and Jim Watson was. And the most recent thing that I did was be on an Electric Research Council goals task force. And we came up with a report which is not many months old now, but it represents the industries' composite report of the research activities that are recommended between now and the year 2000. And they contemplate expenditures, as I recall, totaling about 32 billion dollars. Now this is the kind of thing that'd curl your hair, even if I don't have much to curl.

But here's what happens. The industry spends an abnormally small amount of money on research, and most of that is spent by manufacturers. And that's proper; they develop equipment, and they

have to have research expenditures. But there's a lot of system oriented research that ought to be carried out that's not done. I'm going to just give you some things that I'm not sure are right, but it's close. And this is that the industry income totals some twenty, twenty-one billion dollars made up of fifteen hundred billion kilowatt hours that are sold at an average of about a cent and a third over the United States. Now if you could find a way to get two-tenths of a mil a kilowatt hour assigned to research, this would be \$300,000,000 a year. It could get at a lot of system work--of system performance type of research--that's badly needed, and it could get a system generation research that is, I think, critically needed, particularly like the fast breeder reactor. Where Europeans and others seem to be getting on with it, we sit on our dead fannies here, and it's going to be a critical situation in these United States for fossil fuel and for yellow cake when the middle eighties appear, if we don't have something before us better than the light water jobs.

Well, anyway, this committee recommended expenditures of this large magnitude. And when you consider the revenues, there's no question but what the money is there. It's just a question of making everybody kick in.

CRAWFORD I'm surprised considering the projected energy shortage that the government has not done more about that.

CHAMBERS Well, the government doesn't know how to go about it. The government through AEC has sought to do some

research for this fast breeder, but somehow the funds and approvals don't get provided anywhere in the ball park of what's needed. The proposal has been advanced more than once by even some of the private sector, by the way, that an energy tax be applied of two or three tenths a mil a kilowatt hour. Now this is not palatable to a lot of people, because it represents government intrusion into this area. The whole point here is that you can say--and I think I would agree--that a voluntary research program equitably supported by all segments, public, private, everybody, is desired. The question gets around to how do you do it, and it gets around to dealing with people. This industry is made up of an awful lot--big and small--who somehow are unwilling to provide large amounts of money that would be equitable for them to do. Now some are unwilling, some are lackadaisical, and much of it stems from the fact that the public service commission or some regulatory bodies would give them trouble in the accounting of their contribution, so it's not a simple thing. The leading private group, the Edison Electric Institute, is doing wonderful work, but they have problems of their own, because some of their members are very prominent foot draggers, I understand, in coming forth with their contributions. Some of the worst are the public power sectors who just say, "Let somebody else research into all of this. We're just small." Some of them are large and they don't.

Now this is another delightful thing about TVA--the flexibility that it has. If its board so decided to do it, it can participate in programs, and its board through the years had been the kind that they've been willing to carry its share--do its work. They volunteered for me and a lot of others to work on committees,

and when you look at the public power sectors, as far as I'm concerned, TVA's the top one. We just don't quibble with our responsibility. And in doing this we incurred the admiration of electric systems all over the United States and all over the world for our willingness and our ability to meet our responsibility. Well, that about covers what I did with the cost of power. I tried to do what Jim needed the most.

CRAWFORD What considerations were you having to give to environmental factors by the time you left TVA?

CHAMBERS Oh, tremendous consideration. You see, in addition to being an electric system that should take account of all facets of land use and all air and water effects, we were looked upon as somebody to set examples. I mean that there were people in the legislative and in the executive and judicial--I guess everywhere pointed to TVA and said, "Listen, you lead the way. You're representing the government. You're the one to set an example here." TVA's own board had strong similar views that we should do this. Now this creates a lot of problems. I'm not saying that it creates dissensions, but it creates problems, because so much of the environment treatment is just a question of money. Whatever monies are spent for anything for the power program is going to be reflected in the power rates. If you spent a lot more money, the rates are going to go up. Now there's no question but what the rates ought to increase to the extent required to take account of the environmental impact to the extent required. Now what I'm saying is that everything you do is going to affect the environment. What I'm really saying is

if you don't affect the environment, we quit being a nation and we become a museum or something.

The real trick in this thing is to find the trade-off point and put a dollar tag to establish just what you want to do. You can very easily introduce no heat into water some place. You employ closed circuit cooling towers. The cost of these cooling towers could be from \$15 to \$50 a kilo^watt, and the people who are going to use the electricity are going to pay the cost of it. It's possible that you can introduce heat into the water in a fashion that's acceptable and may even be beneficial to the marine life, the flora and the fauna. This hasn't been established. This is the bad part of this. Some of the environmentalists in their overreaction, which is what I think that it is, have just said, well, zero effect. Well, the same thing is true of emissions to the air. I have a document right now that Central Electricity Generating Board in England prepared that shows some beneficial effects from putting sulfur into the air. In fact, they had an example where they quit and the area around was adversely affected. Now, obviously, you can overdo it. It's a question of establishing what is permissible, what is damaging; and when that's established, then the people who use electricity, by gosh, ought to pay the cost of being assured that those criteria are met.

But you know, there was a guy making a speech here in Houston, and the question came up about the pH factor of water, and he got up on the stand and he pounded the table, and said, "Well, the answer to that is real clear. It'll be zero." Well, you know, pH is--that's a criteria of alkalinity or acidity. But it shows how the overreaction has occurred here. So environmental studies--I think

there's nothing more important at this moment to get on with than establishing criteria so that people don't spend massive amounts of money needlessly or maybe resulting in something adverse even, but yet you do find out what is acceptable some place.

Now TVA's board is very concerned about this. Right now my views of the board are that in case of doubt they're going to say, "Spend the money and be conservative." And I just really feel that the environmental question is the most pressing one on the electric systems today.

CRAWFORD Well, perhaps part of the trouble is that while there are criteria for engineers, there are none for environmentalists or ecologists. Anyone can be an environmentalist with any preparation or background, I suppose, or claim to be one.

CHAMBERS Well, they can talk like this guy did making a speech advocating zero pH factor of the water. Some of them can talk and they almost sound like they know what they're talking about, and some of them, of course, do. It's just so easy to say zero effect, and that's not really what we're after. What we're after, I think, is establishing something that is acceptable--establishing a criteria that is appropriate.

CRAWFORD What estimate would you have made at the time you left TVA, Mr. Chambers, of the future development for power? Would you see it mainly in the nuclear field?

CHAMBERS Yes, I do. The nuclear field, if the fast breeder can be gotten on with--and I happen to be optimistic about this--is going to be the source of electricity. Now, the fusion

technique is going to be pursued. I'm convinced this report that I spoke about, that the task group that I was on, recommended fusion be pursued, but it recognized the likelihood of success was so much greater with the breeder that no further time should be wasted. In fact, we're too late now at getting on with two demonstration plants. As you know, TVA and Commonwealth Edison of Chicago have now joined together in an effort to put in a fast breeder plant that would be supported by those two organizations and also by AEC and also by the utilities industry as a whole, hopefully. Now that's one. This is the kind of thing, though, that's so important that in my opinion if the nation doesn't go into parallel with two, it's making a mistake, because if something happened anywhere along the line with licensing or anything to delay the one, then you really need another one to fall back on, so you don't have to start all over again with some time-consuming losses.

CRAWFORD Well, looking further ahead, do you foresee any other possible sources than nuclear power?

CHAMBERS Well, I guess I'm too old to be a dreamer. I do feel that there's some possibility of getting fossil from some way of recovering the heat from coal under the ground. Now coal--and coal, I think, is the only fossil that's in the realm of consideration for large quantities for future use. I know that efforts are being made to find more gas offshore where we can in the United States, get a pipeline from Canada, liquify some in other countries and ship it here, and do all these things; and I'm in accord with that effort. Oil, I think, has a lot of effort being devoted to it--some

political. I think it ought to be carried forward. Coal is abundant; we have it. We've just got to find a way to use it. Right now the only way we know to do it is to dig it out of the ground, and if we do it underground we're accepting safety situations that we don't like. It's going to be very expensive to meet them, and then maybe we won't meet them. The other way is the surface mine, and that certainly is not satisfactory. Millions are being spent now--and they should be--to restore the surface, but that's a long term thing.

But then when you get it out and you go to burn it, you've got problems. The problems can be overcome if you can gasify and remove the things you don't want to emit to the air. Right now that technique is not available. A lot of work is being done on it. There's one developed by the Germans that I think maybe can work, but in the meanwhile, you're just burning it now and you try to take the stuff out of it. You try to take out particulates, and you can do a pretty good job of it. You try to take out sulphur and nitrogen, and you can't. There are a number of ways which this might be accomplished. Many of them are very expensive, and none of them are definitely a successful type of a thing that you know will work.

But if you can find a way to get some holes drilled or some passages under the ground to get at the coal and get its heat out--and this was tried once. Alabama Power Company worked with the Department of Interior down at Gorgas, Alabama in an effort to do this, and they failed. The prospects are not bright for it, but if something can be done, then that might be in the picture for the future. But unless it is, nuclear, to my mind, is it. Now, I said I wasn't a dreamer. Now the dreamers will tell you how much energy the sun radiates to the earth. The dreamers dream of ways in which

you can capture that energy at some distance above the surface of the earth and somehow transmit it to the earth and have it available. And then there are dreamers about geophysical stuff of getting into the interior of this earth and finding some heat, and this is being done some. There are some things that a person younger than I am might get all gung-ho about, but as far as I'm concerned right now, what I see is light water and hopefully a fast breeder and a way to take the excess heat and either use it or get it to the atmosphere in an acceptable manner. You see, that's where it goes; it goes to the atmosphere. And if you carry this thing far enough, you're going to have problems with the atmospheric absorption. This business of heat and water; that's just a vehicle. You know, you put the heat in the water and from there it goes to the atmosphere.

I'll bet you that question would get about as many answers as: What do you foresee in the future? You'll get as many answers as people you talk to. If you haven't talked to Wessenhauer, you really ought to get him on that.

CRAWFORD I'm looking forward to it. Is there anything particularly that we've not covered, Mr. Chambers, that you'd like to?

CHAMBERS No, I just wanted to emphasize that working for TVA was the pleasantest arrangement that is possible to put together. This doesn't mean that we didn't have differences, and this doesn't mean that the board didn't look down our throats and say, "You do this," and chew us out when we needed it. But it's strictly a dedicated bunch of people. There's nothing that is of consequence that is being dealt with except getting the job done. I didn't see

examples of jealousies. I didn't see examples of foot dragging on cooperation. I didn't see examples of trying to define sharp lines of demarcation between this man's job and that man's job. They, rather, looked each other in the eye and said, "Now, we don't know who this borderline thing ought to go to and I guess we don't really care; let's get it done."

I think I saw more than anybody else in TVA. I saw more examples of people who were envious of me when I would go to a meeting with people from electric systems all over, and we would sit and they would look and say, "Can you do this, can you do that?" And I'd say, "Yes, no, this, this, this." And I'd ask somebody else, "What do you think" "Well, we've got to go back. I'll tell you this fellow we got..." And they found themselves having to check with this man and that man to avoid somebody's nose being out of joint about something. In other words, I could go to a group in the power planning field. Somebody could say something about power system operation, then I could say something for the power system operation people and go back and tell the director of that division, "Listen, I promised somebody you'll do so and so. Now you got to do it." And he did that to me too, of course, but time after time people would come to me and say, "The way you guys work is just fantastic."

And sometimes we'd go some place, and some of our bigshots--not many months ago we went up to General Electric Company, and we sat in a place. And our board chairman, Mr. Wager, was sitting in the front row, and he look around and he said,

"Wait a minute. Let me get Fred up here with me. He learns slow and he'll need to get close." I mean something of that kind would come up and he'd look around and say, "Fred, is he telling the truth about this?" I mean, there's a spirit in TVA that you just don't find anywhere else.



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